The Imperial Forestry Institute University of Oxford

TWENTY-THIRD ANNUAL REPORT

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UNIVERSITY OF OXFORD

TWENTY-THIRD ANNUAL REPORT OF THE IMPERIAL FORESTRY INSTITUTE ACADEMIC YEAR, 1946-47

ALTHOUGH there was a considerable number (about 30) of undergraduates at the University who intended to read forestry, mostly on the special three-year ex-Services course, their time during Term was almost entirely taken up in reading the ancillary sciences in the appropriate Departments. Only one Colonial Forestry Scholar was selected owing to the continued shortage of recent graduates in the biological sciences, but two other graduates, three undergraduates and four ex-Service candidates were admitted to the junior year of forestry, making ten in all. A certain amount of difficulty was experienced (as expected) from the heterogeneity of this class.

The senior year consisted of only seven students, of whom three were Government scholars, one from Jamaica, and two from India: this group sat for the Final Honour School, in which two were awarded Second Class, three Third, and one Fourth, whilst one was not placed.

Two Colonial Forest Officers and six Probationary Officers attended a post-graduate course from Nigeria, Kenya, Tanganyika, Trinidad, and British Honduras.

Four students completed their courses for the post-graduate Diploma, all being successful. They came from Australia, Poland and Austria. Six others were admitted as candidates for the Diploma.

One student from the Gold Coast passed the examination for B.Sc., and one from Australia was working for D.Phil. There were in all forty-four students attending courses.

The nine-month special course for junior Indian Forest Service Officers was repeated with minor modifications based on last year's experience. It was attended by eleven officers from five Provinces of British India and five Indian States (Hyderabad, Kashmir, Mysore, Gwalior and Kotah). The future of this course is naturally uncertain, but some nominations have already been made for 1948.

Continental tours have again been an important part of the courses, particularly for the senior students. The junior year visited Normandy and the Landes; the senior year, the forests of the Jura, Vosges and Switzerland, a tour which was joined by four senior Officers from Australia as well as the Indian class. Twenty-three of these senior students made a tour in Denmark and Sweden with the Professor after the end of the year under report. Once again we are

greatly indebted to the Forest Services of the countries concerned, not only for general facilities, but for much hospitality and for permitting their officers to make most of the arrangements.

Working plan practical work was again done in High Meadow Woods, one of the Forestry Commission forests, and, as last year, a special management exercise was set to the graduate students. A ten-day utilization course was arranged at the Forest Products Research Laboratory for the Colonial Service men in the Christmas vacation, whilst the Indian class also made a visit in March: the help given by the Director and his staff in connection with these visits and to individuals studying Utilization subjects is greatly appreciated. Another tour was arranged in the Easter vacation to East Anglia, mainly to visit sawmills and to see other aspects of Utilization work: twenty students attended.

All students are encouraged to undertake practical forestry work of some sort during vacations before they are ready for these conducted tours and exercises, and are given help in finding it. This year, small parties were doing such work on Forestry Commission forests in the Cheviots (road work), in Thetford and the New Forest (general work); also on private estates in Gloucestershire and Dartington Hall, Devon, opportunities being provided respectively by Mr. Workman and the Trustees through Mr. Hide.

The usual weekly excursions were made during the Summer Term, and our thanks are offered to those who kindly gave facilities and help in connection with them. The places visited were:—

1. Messrs. Mallinson's Timber Yards and Sawmills, London.
2. Eynsham Estate (Mr. Michael Mason).
3. Ebworth and Popes Wood (Mr. Workman).
4. Elstree (Aerial Photography Branch).
5. Bagley Wood (St. John's College).
6. Imperial Institute, London.
7. Parmoor and other Beech Woods (Mr. Bourne).
8. Hampden Beech Woods (Mr. O'Hara Taylor).
9. Bramshill (Forestry Commission).
10. Boughton Estate, Northants (Duke of Buccleuch).
11. Forest Products Research Laboratory, Princes Risborough.
12. Stanton St. John Woods (New College).

It can be claimed that this year practical work and tours were fully back on to the pre-war standards, and have in fact been strengthened in certain respects notably on the Engineering and Utilization side.

It may be mentioned that all senior students take part (one of them as leader) in a series of open discussions of forestry topics chosen as of wide interest. The objects are to elicit and share the varied experience of those taking part, coming as they do from all

parts of the world, and to give some training in conducting such discussions. The subjects discussed this year were :—

The use of cameras and photographic accessories in Forestry.
Importance of Forest Genetics.
Wood Fuel.
Processed Wood versus Timber.
The Forest Entomologist.
Forestry in relation to soil fertility and conservation.
The adaptation of shifting cultivation methods to organized Forestry.
Location of the Colonial Service Refresher Course.
The rehabilitation of degraded woodlands.
Forestry and Land Planning.
Forestry's contribution in the development of a Colony.
The handling of Forest Labour.
Nursery Management.
Use of Exotics.
Reciprocal benefits of Agriculture and Forestry.
Utilization of Waste Lands.
State Control of Private Forests.
Farm Forestry.
Forest Education.
Transport facilities of forest produce and conditions required for their developments.
Conditions required for developing forest industries and effect of industrial needs on forest management.
Amenities for forest staff.
Fire in relation to productivity of forests.

It has still not been possible to complete working plans for the Wytham Woods and Bagley Wood owing to the heavy demands on the staff concerned not only in Term time but also during the vacations. However, further progress has been made, notably in Wytham, where the first plantation (twenty-five acres with mixed softwood and hardwood species) has been made, the area for the second cleared, the nursery fenced, and a saw-bench for firewood and fencing posts installed. Both woods were much used for instruction work.

Many of the staff have had much less time for research work this year than previously owing to the increased number of students, particularly senior students requiring individual attention. We have also been hampered by serious overcrowding and difficulties in securing delivery of apparatus. Nevertheless, a good deal has been accomplished as detailed under the various sections.

It was noted last year that the Forestry Commission has set up a new Research Centre in Alice Holt Forest in Hants. They did not find it practicable to keep the Research Officer, England and Wales, at the Institute, but it was arranged that one of their staff should pay regular visits to ensure liaison, and this has been done. The Research Nursery at Kennington will be maintained at least for the

present; this is fortunate, as it is used a good deal for instructional purposes, and the Forester-in-Charge, Mr. Grey, is most helpful in this connection.

An arrangement has been made under which Dr. Chrystal will give more assistance to the Forestry Commission in connection with their Foresters' Schools, whilst the Commission will make a proportionate contribution to his salary permitting of the employment, it is hoped, of an additional entomological assistant.

The research team working on the relation between tree growth and soil was greatly delayed in its programme of field work by the difficulties in getting the projected field station near Allerston Forest (in Yorkshire) set up and equipped. When two huts in a labour camp were finally made available by the Forestry Commission, our staff had to do a lot of work fitting them up for use. This involved much loss of time, and experimental work could only be initiated long after the beginning of the growing season. Even now, all the necessary equipment has not been received, but the position is fairly satisfactory; some field work has been done and all should be ready for Spring, 1948. The team has been supplemented by two additional members maintained from a special grant from the Forestry Commission. The intention is that they, Mr. Rennie from London University and Mr. Murphy from National University of Ireland, shall work with the senior members for a few years, becoming familiar with methods of study, etc. in this field, and subsequently be available for work on specific problems as they may arise in the Commission's Forests; detailed arrangements are still under discussion. During the year two members of the team have travelled on the Continent and made valuable contacts with Continental workers in Holland, Denmark and Sweden.

Good progress has been made in the referencing and index section of the Library, and the heavy arrears of work have been mostly cleared off. Close co-operation with the Imperial Forestry Bureau has continued; a new Director has now (July, 1947) been appointed, Mr. F. C. Ford Robertson, who retired from the Indian Forest Service to take up the post.

Regular arrangements have been made with all the Colleges for tuition in forestry subjects through a Tutorial Board of the Institute staff. This ensures that students reading Forestry get the same amount of individual help and tuition as students reading other subjects, which has not always been the case in the past.

It is important that the teaching staff should maintain the closest contacts with the progress of practical forestry in this country. One of the best ways of doing this is by serving on committees, etc., dealing with the subject, and it is accordingly satisfactory that Col. Lloyd has been appointed to the East Regional Advisory Committee of the Forestry Commission and Mr. MacGregor to the secretaryship of a special Economics Committee of the Royal English Forestry Society.

The Institute has participated in Forestry Exhibits at three of the larger Agricultural Shows held during the year, *viz.* those at Cheltenham, Lincoln and Carmarthen. Dr. Chrystal has dealt with this with the assistance of Mr. J. S. Shaw.

One of the chief forestry events of the year was the holding of the Empire Forestry Conference in this country after a twelve-year interval instead of the normal five years. Whilst most of the meetings took place in London, three items on the Agenda were discussed between July 4th and 7th at Oxford, when the whole Institute staff had the opportunity of meeting the Conference delegates. The Institute made all the arrangements for this visit and organized a small exhibition with the primary object of demonstrating the research work in progress. One of the subjects discussed was the needs of the Institute itself, and it was hoped that some further support would be forthcoming from the Dominions. The Chairman of the Conference made an appeal for a large sum of money to further Empire forestry through the Imperial Forestry Institute and other organizations. The Professor contributed two papers to the Conference and opened the discussion on Forest Genetics, a subject which has so far been much neglected in this country.

The new building progresses and the latest information is that it is expected to have the roof on before the winter of 1947-48. Further delays appear likely over plumbing, wiring and furnishing. So far no timber whatsoever has been obtained for flooring, doors and windows, panelling, etc. As far as the supply of timber itself is concerned, very generous offers have been received from all parts of the Empire, but it has to be transported, processed and fitted, and this calls for permits, funds and labour, all of which seem likely to involve difficulties. It now appears optimistic to expect to get in even by October, 1948. By drastic rearrangement and further crowding, it is hoped to accommodate staff and students during the coming year, but it will not be possible with the increased number of students who will be working in the Department in 1948-49.

The Professor made an exploratory tour in Denmark in August, 1946, and subsequently, as a member of the U.K. delegation, attended the second conference of the U.N. Food and Agriculture Organization at Copenhagen. On the basis of these visits, it was decided that Denmark had various features of definite instructional value to our students, not so well developed in the other countries visited, and a senior students' tour was accordingly planned to precede the tour in Sweden. A similar brief exploratory tour has been made (September, 1947) to Finland.

The teaching staff was strengthened by the addition of Dr. M. L. Anderson, who resigned his post as Chief of the Eire Forest Department, to join the Institute. His chief work will be in British Forestry practice, but he is also taking over the teaching of Mensuration from Mr. Brasnett, who will thus have more time for Management and Colonial subjects.

Dr. Anderson joined most of the Continental tours travelling on a special grant from the Carpenters' Company of the City of London, making a special study of the management of privately-owned forests. Mr. J. P. M. Brenan left for an extended tour of Northern Rhodesia to study the flora just after the end of the year, and he will join a research party on botanical ecology in West Africa before returning: Dr. E. W. Jones will also be a member of this party, which leaves England in November for three months.

SILVICULTURE

Dr. E. W. Jones conducted the usual courses. A new course on general ecological principles was organized primarily for the post-graduate students and given jointly by Dr. Jones, Dr. Leyton and Mr. Dimbleby, each dealing with certain aspects of the subject. Research students were working on the effect of grass on tree growth and the natural regeneration of Scots pine.

Some of the research work described under Forest Pathology below deals with the effect of site factors on growth.

The Professor gave a course of lectures on Tropical Silviculture.

SOIL ECOLOGY

The experimental investigations of the Soil Ecology team have been helped by the arrival of substantial additions to equipment and the setting up of a field laboratory at Birch Hall Camp (a Forestry Commission trainee camp) in the Hackness district of Langdale Forest. It is a source of some disappointment that the field laboratory was not available for use in the Spring of this year and only after strenuous manual efforts by the team was it made available for work this season. Mr. Dimbleby has now made a preliminary ecological survey of the area and is in a position to follow up with experimental investigations.

During the year a number of visits and contacts with workers in similar fields in other countries have been made. Dr. L. G. Romell, who was so helpful in Sweden last year, paid a visit to this country, and during part of his tour two members of the team spent a few days with him and Dr. Levisohn on the Wareham Heath experimental area, and also in examining regeneration problems in the New Forest. At Easter, Dr. Leyton attended the Conference of the Society for Experimental Biology held in Utrecht, and made contact with workers in similar fields, and especially with Professor van den Honert, who is also interested in the relations between root metabolism and mineral nutrition in plants. During the Summer Dr. Handley attended the Fourth International Microbiological Congress held in Copenhagen in July. Before and during the Congress, visits were made, in company with Professor E. Björkman of Stockholm, to a number of forest nurseries in various parts of Denmark for the purpose of studying maintenance of fertility. The opportunity

was also taken of visiting the dune and heathland plantations of Jutland to study mycorrhizal associations under conditions relatively difficult for tree growth. Another visit of particular interest was made to Dr. C. H. Bornebusch, Director of the Danish Forest Experimental Station.

During the past academic year a number of students have carried out work for their special subjects in problems closely related to the work of the team. These studies have included the development of an integrating light meter for use in forest investigations, attempts being made to render the instrument automatically recording. A second student has worked on techniques for the investigation of soil atmospheres, and a third has been engaged on a preliminary investigation of variations in the biological activity of various types of Scottish peat under various experimental conditions. The results appear to indicate that there may be a relationship between the rate of decomposition of cellulose by peat, especially after drying and addition of phosphate, and its suitability as a site for the establishment of tree growth. There are many other problems which could usefully be taken up in the same way by senior students or graduate assistants. Thus it has been arranged that a student will follow the development of crumb structure in the soil of plots under various treatments, such as grass ley, bare fallow, weeds, and straw mulch in Kennington old nursery.

Space and glass-house facilities are now needed for the experimental treatment of tree seedlings and young trees. The experimental investigations of the team are following the general lines indicated in the report of 1946 and are as follows.

Ecology (Mr. G. W. Dimbleby). The establishment of the field laboratory has provided the necessary base from which to carry out the ecological attack on the problems of tree growth that are encountered on these moors. An extensive survey has been made of the ecology of the Lower Calcareous Grit which gives rise to the difficult podsols of this area, and particular sites have been selected for detailed study by the field methods developed during the past two years. The investigations made so far give a useful indication of the potentialities of this soil type under different conditions. Much experimental work, both in the field and laboratory, will have to be done before the basic causes of tree failure are recognized, but the first steps have been taken and are distinctly promising. It is a considerable advantage that so many experimental plots of long standing exist on this soil type.

Tree Physiology (Dr. L. Leyton). Investigation into the effects of aeration on the nutrient uptake of various species continue. The necessary apparatus has been installed and some preliminary measurements have been made, the results of which suggest interesting correlations with ecological behaviour. The nutritional status of trees as determined by needle analyses is being studied in relation to growth vigour and in particular to toxicity of iron and

aluminium. It is hoped to correlate these analyses with soil conditions, especially conditions of poor aeration which appear conducive to unbalanced nutrition.

Microbiology (Dr. W. R. C. Handley). With the facilities at present available for the study of the mycorrhizal association, research continues from the point of view of the processes involved in infection of tree roots by the mycorrhizal fungi, and the effect of various environmental factors on these processes of infection. An investigation of the hop waste compost effect in moorland nurseries has commenced, and involves general considerations of fertility in forest nurseries.

FOREST BOTANY

Mr. A. C. Hoyle, Curator of the Forest Herbarium, continued to work at the Institute and to undertake the teaching and supervisory work in systematic botany and tropical ecology needed by the students of all categories. Mr. J. P. M. Brenan similarly continued his work on plant identification and check lists. The Tanganyika check list, much the largest undertaken so far, is in the Press, and it is hoped that it will be published during 1948. The assistant, Mr. H. L. Dunkley, was transferred from the Forest Herbarium to the Institute, but resigned after the end of the year to take up another appointment elsewhere.

The usual courses were given, as well as a field course on soil and vegetation survey in Wytham Woods carried out with the co-operation of the Soil Science Laboratory on the lines tried out last year.

There was, as anticipated, a large increase in the number of herbarium accessions, from 840 last year to 3,243 this year. Major contributions came from Nigeria (Forestry Department), Tanganyika (Mr. P. J. Greenway), Somaliland (Department of Agriculture, 539 specimens), Southern Rhodesia, Gold Coast, Bechuanaland, Sierra Leone, Sudan and Uganda. Consignments were also received from Brussels and Syracuse (U.S.A.). The number of specimens mounted during the year has also increased by over 50 per cent. to 3,533, but there is much work to be done in putting them in their appropriate sections of the herbarium.

Both Mr. Hoyle and Mr. Brenan will be travelling in Africa during the coming year.

FOREST PATHOLOGY

Mr. W. R. Day continued in charge of the section with Mr. F. H. Jones as senior assistant and Mr. D. Barrett as junior assistant. It is hoped to arrange additional assistance, as much of Mr. Jones's time is taken up by his duties as Head Laboratory Assistant.

Teaching. Courses of instruction were given in forest hygiene and pathology including a special course of lectures for Indian Forest Officers. Two graduate students undertook small pieces of research work, including a study of the variations in European larch from

different localities. This work suggests that it may be practicable by means of physiological tests, relatively expeditiously to determine comparative differences in frost hardiness between the strains from different regions.

Research

(*a*) *Root disease and butt-rot of conifers*. An examination was made in the late Winter of 1946 of the root systems of various species of conifer growing in Bagley Wood, many trees having been overturned by an exceptional gale. These trees had been growing on ground with impeded subsoil drainage. The examination showed that dead secondary roots are frequent wherever the drainage conditions are such that waterlogged conditions are maintained intermittently for long periods: they also occur, but less frequently, in the upper soil layers which are known on occasion to suffer severely from drought. Isolations of possible parasites were attempted from areas of dead bark which occurred on these root systems at places where there was no mechanical injury and where it was plain that death had taken place recently. A fungus known to be the cause of root decay and butt-rot was isolated in only three trials out of thirty-six: in most cases the bark proved to be sterile or to contain bacteria. This seems to show plainly that the early stages of root disease are not necessarily produced by the fungi which later are found to dominate on the diseased root system or to be causing butt-rot in the main stem. Further evidence was obtained from a young Douglas fir plantation in Shropshire established on soil derived from Triassic Sandstone and infected with *Fomes annosus*. The anatomy of the root systems of these trees showed quite clearly that a partial dying of the roots had taken place owing to non-parasitic factors; that a recovery in growth had followed, with infection succeeding quickly after it.

These observations support the conclusion already reached that the physical make-up of the soil, including the water-air regime which prevails within it, usually provides the fundamental conditions for the infections that accompany the dying of roots and result in the development of butt-rot.

(*b*) *The infection of roots of large conifers with species of Phytophthora* (*and possibly Pythium*). This was mentioned in last year's Report: it is really an aspect of the work mentioned above. The various isolations attempted have frequently proved to be mixed, and, taken as a whole, they give plain indications that more than one species of fungus occurs. Time has not been available to sort out this complex, but work on it is proceeding and it is hoped that the position will be clearer during the coming year. Other cases are gradually appearing in which there is an absence of any of the higher fungi associated with root disease of conifers; in one such case (Sitka spruce in Kerry Forest, on the borders of Shropshire and Montgomeryshire), there seems to be a clear association between root disease and shallow soil over a badly-drained subsoil.

(*c*) *European larch.* (*i*) The relative susceptibility to frost injury of different provenances (taken from the region which includes the Alps and the Sudeten Mountains) was the subject of further study. The refrigerator experiments mentioned last year have shown that (1) there are markedly significant differences in frost susceptibility between different provenances of E. larch as tested in a refrigerator: (2) they suggest that (as tested at Oxford) if the elevation of the provenances is the same, susceptibility decreases as the latitude becomes more northerly: (3) that, if elevation and latitude are the same, susceptibility is highly correlated with date of flushing. The material was not adequate to test the variation in susceptibility with change in elevation, but it is believed that a direct correlation exists. For two of the provenances, Mr. Varma tested the point at which irreversible plasmolysis occurs in the cortical cells of small branches when sections are placed in osmotic solutions. It has been suggested that susceptibility to irreversible plasmolysis is directly correlated with susceptibility to frost injury and in the two cases tested this proved to be so. It is hoped to carry this work further during the coming year.

(ii) One lot of European larch of Scottish origin was tested with the above. It proved to be one of the more susceptible and so it is proposed next year to carry out similar tests on a number of lots from plantations in different parts of Scotland. Two lots of Japanese larch were also tested, one lot raised from seed from Denmark, the other of unknown origin except that the seed had been bought in Cologne. The two lots proved to be markedly different in susceptibility.

(iii) In order to fill a lacuna in the data available with regard to larch die-back and canker, it was decided to survey and map the variations which occur in disease and stocking in typical plantations. Those chosen for survey occur in Mortimer Forest, in Herefordshire and in Coed-y-Brenin in Merionethshire. Mr. F. H. Jones was in charge of the survey in Mortimer Forest and Mr. Pinchin, Research Officer, Forestry Commission, in Coed-y-Brenin. The surveys have been completed but the maps and statistical data are still in process of preparation.

(iv) It has been decided that the results of the work on European larch, in progress for more than a decade but greatly interrupted by the war, should now be prepared for publication. This will be done in collaboration with the Forestry Commission; it involves a very considerable amount of work.

(*d*) *The occurrence of cankers on the butt length of main stems of conifers, in plantations in the pole stage, after pruning or brashing of side branches.* Several interesting and possibly important examples of this have occurred recently.

(i) Cankers resembling larch cankers in development have been found at the base of Corsican pine in Allerston (I) Forest, Yorkshire. The anatomy of these cankers indicates that frost injury is

the basic cause of their development though there may be no injury to the crown of the tree, despite the fact that in this forest serious frost injury to the crowns of this species does occur. Two species of fungi were isolated but their importance, if any, is considered to be secondary.

(ii) Specimens of Norway spruce from a green-pruning experiment in a plantation on Drummond Hill, Perthshire, were examined at the request of Mr. C. W. Scott of the Forest Products Research Laboratory. The material gave clear indications that a non-parasitic factor had caused the cankering and again this must have been frost. The possibility that the pruning of live branches had stimulated the cambium to maintain a longer growing season than otherwise would have obtained, seems to be indicated but this needs to be examined experimentally. In the meantime, it has been agreed with Mr. Scott to make an examination of sample material with a view to determining the consistency with regard to type and date of occurrence of the injuries in the various (seasonal) pruning treatments applied to these spruce. Much work will be entailed and it has only been undertaken on the condition that no strict time limit is set.

(iii) Plantations of Japanese larch were examined at Coed-y-Brenin which were, in part, severely affected by canker. A preliminary examination of material from these plantations shows it to be another case of frost injury. A small number of trees in the affected plantations had been left unbrashed and these had escaped injury although standing among severely affected trees. As brashing normally involves an appreciable amount of injury to living bark around the base of branches, this case seems to fall in line with the Norway spruce as an instance of the development of frost susceptibility after wounding during the removal of side branches. The suggestion that wide variations in frost susceptibility occur within Japanese larch as a species may plainly be of considerable importance in connection with injuries of this sort.

The observations here recorded plainly indicate the desirability of investigating the relationships that exist between the pruning and brashing treatment received by pole crops of the above species and Sitka spruce, the length of growing season of the cambium, and its susceptibility to frost injury during the period between the Autumn and the Spring when the more severe frost occur. Meteorological observations in the forest are desirable. So far there has been no indication that parasites play any part of importance in connection with this phenomenon. There is, however, no doubt that heart rot in the butt length will usually develop as a result of it.

(*e*) *Other items*. An interesting case of the dying back of Japanese larch was examined at Fontmell Hill, Dorset, on the estate of Mr. Balfour Gardner. The affected plantation is on chalky soil and had grown well until within the last few years. The die-back affects the top of the crown and seems quite clearly to be caused by frost injury and probably in part at least by Autumn frost. The trees are in the

pole stage and grow in a valley in which severe frosts are to be expected. The occurrence of severe injury only when a dense pole state has been reached agrees with the development of frost die-back in European larch and Corsican pine which also tends markedly to be most severe after a closed canopy has been formed. This phenomenon seems to be related to the restriction of air circulation within the plantation and is one of the matters which need investigation meteorologically.

Several other instances have been noticed of injury by the severe frosts which occurred during the exceptionally cold winter of this year, and, according to Mr. T. R. Peace, Pathologist to the Forestry Commission, such injury is widespread on some species such as Scots pine and Douglas fir. In some cases, the pattern of die-back is similar to that which often occurs with European larch, in that the twig ends have escaped without apparent injury while the larger parts or thicker branches have been girdled. The result of this was that the injured branches flushed normally in the Spring but then rapidly showed fading and wilting of their leaves.

Material was examined from Lombardy poplars in Devon which were suffering severely from die-back. Frost injury followed by bacterial infection were the principal factors indicated as the causes of disease. Re-examination of slides prepared from early stages of bacterial canker indicates that susceptibility to frost injury is one of the factors which has to be taken into account when investigating the causes of differences in immunity of different poplar strains to bacterial canker.

Some observations were made (in September, 1946) on a small area of Sitka spruce in Brechfa (I) Forest, Carmarthenshire, in which great variations in rate of height growth occur, some of the trees being strongly in check while the better trees are growing moderately well. The soil conditions are approximately the same over the whole area except that there are very considerable variations in depth. The observations suggest that the variations in rate of growth are determined to a considerable extent by conditions which depend on soil depth and that probably the water-air balance in the relatively shallow depth of easily rootable mineral soil is of great importance. The dominant plants in the ground vegetation in this area are *Pteridium aquilinum* and *Calluna vulgaris*: the predominance of the latter is directly correlated with shallowness of soil. Severely checked growth is directly correlated both with predominance of *Calluna* and, necessarily also, with shallowness of soil: even when check is relieved, the quality of growth will necessarily be very low on the 'checked' areas because of the fundamentally inadequate physical conditions prevailing. These observations seem clearly to indicate the necessity of isolating and recognizing the effect on growth of the various soil factors, when investigating problems in pathological debility which result in checked growth; and particularly when attempting to show the influence of an intermixed species in relieving such debility.

FOREST ENTOMOLOGY

Dr. R. N. Chrystal continued in charge of the Section with Mr. E. R. Skinner, returned from War Service, as assistant.

Teaching.

The prescribed courses in forest zoology were given during the Hilary and Trinity Terms.

The short course of instruction in forest entomology, restarted in the Summer of 1946 at the Forestry Commission's Foresters' School, Parkend, was continued in April and July of the present year with a class of thirty-five students. These courses of instruction are now being extended to the other Foresters' schools at New Park, Lyndhurst, and Lynford Hall, Norfolk. Similar courses are being given in these schools this Autumn, the number of students being forty in each case.

At the request of the Royal English Forestry Society, a talk was given to members of the Short Course for Landowners at the Royal College of Agriculture, Cirencester, in April, on 'Sucking Insects, their habits and control.'

Research.

The Douglas fir Adelges. The study of this pest was continued throughout the year. At Tubney, as a result of the unusually severe Winter, the density of the *Adelges* population was in general very much reduced in comparison with previous years. This phenomenon was general all over the country, and affected not only the Douglas species, but also the gall-stages of the common species on the spruce. The first visit to the Welsh areas was made in April when the Cae Cyrach and Ffrid Goch plantings were examined, a second visit being made in August. In April, countings made of the wintering forms on trees in the underplanted Douglas in Cae Cyrach showed great concentrations of these forms on the suppressed trees with thick foliage up to the leader, as compared with the concentration on the faster growing, more open foliaged trees. Later in the season, it was obvious that over the whole area the same reduction in density had occurred this season as had already been recorded at Tubney. This had been remarked upon by the forester who said that it was common to the whole district. All activity of the Summer generation had ceased by early September.

Experiments on the use of 'Tanglefoot' for prevention of Adelges migration from tree to tree or from one branch to another were made at Tubney and in an experimental plot at Kennington Nursery. Their initial object was to test the degree of protection afforded to shoots while studying variation in shoot development in attacked and unattacked shoots. In the case of the plot at Kennington, the tanglefoot bands were used to protect the whole tree from infection. The experiment was successful in both cases, and no damage to the trees resulted. At Tubney, the experiment gave some useful data on the

movements of the *Adelges* indicating by the masses of dead insects on the bands that there had been a general move towards the leading buds. Several artificially defoliated branches treated in this way (all needles having been removed previous to the flushing of the buds) showed that the *Adelges* would come from a considerable distance to migrate on to the flushing buds.

The study plot, established at Kennington in 1946, was brought into use this Spring. A number of trees of approximately the same height and vigour of growth was selected. Half of them were artificially infected with *Adelges* and kept as far as possible at a saturation density of attack. The remainder were protected by tanglefoot bands. The experiment was started early in May when the egg-stage was at the maximum. Infection proceeded normally during May and June, and the first comparisons were made early in July. Comparisons showed that the shoots of the current year had been blotched to a yellow colour, and showed a pronounced degree of needle distortion, together with a measurable reduction in the shoot length as compared with the control trees. This reduction in growth appears to have been directly due to the heavy attack induced, but at the same time the attack was on a much heavier scale than occurs under natural conditions. The condition of these trees will be studied this Autumn and next Spring.

In other cases, selected trees were pruned of varying percentages of foliage, and saturation infection carried out. So far, trees with half of their foliage removed and the remainder infected up to saturation point are still living, and they show a current shoot growth equal to that of infested trees which were not defoliated. Migration of the *Adelges* from tree to tree occurred in the plot, some trees on the plot margin, not included in the trials, being infected. Cameron, working in the Scotch plantations, has already shown that this migration takes place along the ground.

It has been determined that the first Spring migrants seek out the unopened buds and congregate in numbers on them. They then proceed to make their way under the bud scales and settle on the needles which are still closely bunched together. These needles, still in a soft condition, are often bent, and attack at this stage is probably the cause of the needle deformity so often observed at a later period.

It has also been noted that there are differences in severity of infestation on what are apparently different strains of the Douglas fir. Chemical analyses of needles from each type of tree are being made by Dr. Leyton, who has kindly offered to collaborate. It is also thought that there may be some mechanical factor responsible for the phenomenon that on the one type of tree the *Adelges* mass quite freely, while on the other they are very sparsely distributed. In the latter type of tree it has been noticed that the blotching marks differ in size and shape from those on the other.

Reference has already been made to the avoidance by *Adelges* of trees unhealthy from one cause or another. It has again been much in evidence at Tubney this season, all trees that fall victims to fungus root attack being clear of the insect. It was also observed recently on a much larger scale in a remarkable Douglas plantation in the Wardour Castle estate woods.

MENSURATION AND MANAGEMENT

During the year Mr. N. V. Brasnett and Dr. M. L. Anderson have both participated in the teaching of these subjects. In future it is planned that the former will deal mainly with Management and Colonial Forestry, and the latter with Mensuration and British Forestry, both collaborating over practical field work including working plans, tours and excursions. The Working Plan work of both junior and senior years was carried out at Easter in High Meadow Woods: weather conditions were exceedingly unfavourable for the former. The Colonial Service class spent two weeks on a special exercise involving a measure of precision obtained in sample enumerations of different intensity.

The students going on the tours received lectures on Continental working plans, and several took up studies of special management problems. Similarly, a course of lectures dealing with selected points in forest mensuration and the application of statistical methods was given to the Colonial and Indian Service students. A sample plot was thinned and remeasured in the *Cedrus deodara* plantation in Bagley Wood. (It has unfortunately been badly damaged by a violent wind storm since.)

Further consideration has been given with the co-operation of the University Lecturer in the Design and Analysis of Scientific Experiment, to the efficiency of various sampling methods.

Dr. Anderson took up the preparation of the working plan for Wytham Woods. He completed the preliminary survey and started on the detailed examination of the existing crops.

STATISTICAL SECTION

Our computer, Miss Faulkner, unfortunately resigned just when she was becoming useful. Miss J. Smith now holds the post and is satisfactorily in process of training under Mr. Day for this work. She has largely been engaged in the sorting and tabulation of Mr. Day's data and in the preparation of diagrams and maps from these.

Fortunately there has not been so heavy a demand for statistical computations as last year owing to changes of staff and pressure of teaching work.

WOOD STRUCTURE

The usual undergraduate and post-graduate courses were given and some courses for senior students, including supervision of three Diploma students.

Apart from teaching, Dr. Chalk was engaged almost entirely on the book on systematic anatomy to which reference has been made in previous reports. All the line drawings were completed and the final revision was started.

Further additions to the wood collection have been made, the principal ones being from the Laboratoire d'Anatomie des Bois du Ministère des Colonies, France (per Monsieur D. Normand), the Forestry Departments of Chile and Jamaica (per F.P.R.L., Princes Risborough), and the Director of the Botanic Gardens, Singapore, and the Zaagmolen Nieuwe Onderneming, Paramaribo, Dutch Guiana, at the request of the Pica Company in Eindhoven, Holland. There has been an increasing demand for photomicrographs and microscope sections of woods.

FOREST ECONOMICS

Teaching.

Mr. J. J. MacGregor gave a course of lectures in forest economics, following an introductory course on general economic theory, to senior-year students and Colonial Probationary Officers. A similar course was given to the Indian graduate students.

Research.

The work begun in the previous year with private estates and colleges was continued. For three estates the accounts are being analysed on a comparable basis over a period of years, with the intention of publishing them as 'case' studies. These studies should provide details of many economic features of forestry and at the same time show the policy of private estates towards the woodlands as a separate enterprise.

The Forest Economist was appointed to the Oxford and Bucks Divisional Committee of the Royal English Forestry Society. At the request of the Secretary of the Regional Division of the Society a talk was given on the place of 'Woodland Accounting in Management and Economic Research.' Arising directly from the suggestion put forward in the discussion following this talk, the Royal English Forestry Society appointed a Costings Committee for which the Forest Economist is Secretary. These close connections with the Society are regarded as extremely helpful in establishing contact with private estates and facilitating access to information of value for teaching and research. A talk on Woodland Accounting and Costings was also given at the Refresher Course for land owners and agents arranged at the Royal Agricultural College, Cirencester, by the Society.

On the occasion of the visit of the Empire Forestry Conference an exhibit was prepared to illustrate the research work in forest economics. It consisted of charts comparing the price movements of certain categories of timber imports with the movements of forestry wages and the general price level, and others illustrating the supply and price position of home and imported timber during the war years.

BRITISH FOREST LAW, LAND TENURE AND TAXATION

This is now an optional subject in the Honours School but is expected to be taken by all candidates intending to take up forestry work in Great Britain. As several students were taking it, a course was given by Mr. J. J. MacGregor.

COLONIAL FORESTRY ADMINISTRATION

Mr. N. V. Brasnett gave a course of lectures on this subject which is similarly optional for Honours School candidates but attended by all Colonial Service students. He also gave a course of nine lectures to the Colonial Administrative Service Cadets at Cambridge, the Professor giving a final lecture there and a parallel course at Oxford.

FOREST ENGINEERING AND UTILIZATION

Colonel Lloyd has been able to build up further the instruction and practice in these subjects. As last year, a ten-days' course was conducted at the Forest Products Research Laboratory in seasoning, wood preservation, timber mechanics, wood chemistry and general utilization, and special attention was given to the engineering and utilization aspects during the tours in S.E. France and Switzerland. In the section of Timber Mechanics the students carried out practical timber tests and worked up the results individually. A brief visit was also paid to the Laboratory in May by eleven Indian Forest Officers, and several students were given individual assistance in Utilization studies during the year. The help given by the Director and staff of the Laboratory is greatly appreciated.

An additional tour was carried out in the Easter Vacation to East Anglia attended by twenty students. Visits were made to Messrs. Sadds' sawmills at Maldon, William Brown's mills at Ipswich and the Forestry Commission Timber Depot near Brandon. During the Summer Term visits were made to Messrs. Mallinsons' timber yards and sawmills in London; also to the Imperial Institute, where minor forest products were studied.

Instruction and practice on road alignment and compartment boundary surveys was given to sixteen students in the Easter and Long Vacations in the Forestry Commission's lands in the Cheviots. Modern road construction and metalling were studied in progress through the courtesy of the Oxfordshire County Surveyor.

Arrangements were made for a junior Forestry Officer from Cyprus to take a special two-year course in Forest Engineering. This included four months' practical work in sawmills and study-visits to various engineering works, a course in telephone line construction under the G.P.O., and a building construction and mechanical course at Birmingham.

An Australian Forest Officer submitted a Forestry Diploma thesis on 'The utilization of small timber and its effect on forest management,' and in view of the present importance of the use of thinnings to British Forestry, a visit was made by a party of students to Thetford, where the preparation, handling and disposal of softwood thinnings was studied.

SURVEYING

Mr. O. H. Chilton gave the regular course of surveying in the Michaelmas Term.

LIBRARY

The following figures give comparative statistics showing differences from last year in the volume of work in the library.

Accessions:	2,376	(increase 90)
Separate issues of periodicals	1,307	(,, 134)
Books	88	(,, 28)
Other items	981	(decrease 72)

NOTE: The Imperial Forestry Bureau provided 251 items; the British Council 10; we received 23 gifts and 166 items on request; one book was purchased by means of the Brooks Fund.

Loans:	4,872	(increase 871)
To staff	2,058	(,, 100)
To the Imperial Forestry Bureau	856	(decrease 27)
To students	1,619	(increase 839)
To visitors and correspondents	339	(decrease 41)
Readers in the Library:	5,491	(increase 1,778)
Staff, including Bureau staff	937	(decrease 217)
Students (by reading-periods)	3,996	(increase 1,999)
Visitors	508	(decrease 54)

NOTE: As a full record cannot be kept, these figures are incomplete. The total given in last year's report, 2,913, was a misprint for 3,713.

Current periodicals now number 123, twelve more than last year: whole sets 229. Among new periodicals begun are four French, two Italian, one Czech, one Bulgarian and two Indian.

Series other than periodicals increased by 46. A recent survey shows that the library now holds approximately 5,000 books (titles), 3,500 bound volumes of periodicals, 1,400 separate series by titles, and publications estimated at 20,000 either within those titles or filed under subject only.

Letters and Sales. Letters received 773; sent (a large proportion being requests), 1,347. Sales in the library brought in £20; the selling of our own publications has now been transferred to the Office.

In June the Assistant Librarian, Miss Aspin, resigned: she had been with us since April, 1941, and a tribute must be paid to her for her excellent work. A temporary appointment was made shortly after the close of the year. In April a start was made in preparing for publication a List of Periodicals and Serials held in the library: this task will take about a year to do, the number of entries being estimated at 2,300, including cross-references.

Mr. Hemmings continued to act as Assistant in charge of the card indexes. The main arrears of the current bibliography having finally been incorporated into the current catalogue, the year's work was chiefly concerned with the 1934-35 arrears and current accession. Revisions of classifications received from the Bureau entailed much extra work. Work was hampered by the frequent unavoidable use of the room housing the Catalogues for lectures and discussions during Term.

On an invitation from the British Society for International Bibliography, Mr. Hemmings read a paper at its October meeting in the British Institution of Electrical Engineers, London. The paper dealt chiefly with the progress and problems of the forestry bibliography.

The Bibliography was exhibited to the Empire Forestry Conference and attracted much attention and increased demand for copies of the classification.

Statistics:

1934-35 cards typed and filed	5,901
Current author cards	3,585
Current subject cards	3,530
Total number of current cards added to the Bibliography during the year under review	13,207

The work on the author index to material between 1900 and 1934 is now approaching completion; by the end of July, 16,240 cards had been typed, of which some 12,000 had been arranged alphabetically and filed ready for use; another 4,300 had been typed but awaited sorting and distribution, and in some cases checking. The figure of 4,300 includes a small number of queries still to be settled.

This author catalogue, begun early this year and now within sight of completion, has already proved very useful to staff-members and students.

A large amount of recently acquired pre-1934 material was classified and filed.

The new arrangement of the library books under the decimal classification has been found very satisfactory in practice.

For the Empire Forestry Conference in July, a display showing library activities made part of the Institute exhibition; two maps giving data on (1) exchanges with Empire and foreign institutions and (2) loan facilities with other libraries in the United Kingdom were especially interesting to the Delegates.

Among visitors to the library were persons from China, Finland, Denmark, India, Holland, Belgium and the United States of America.

Those who made gifts during the year are warmly thanked for their kindness. In particular we should mention Professor Blackman, Mrs. Lonsdale Ragg, the British Council, the Minister Plenipotentiary of the Dominican Republic, Hr. Finn Frost, Mr. G. S. Cansdale, Mr. J. H. Chinner, Capt. G. S. Greene, Monsieur D. Normand, Professor Aldo Pavari, Dr. A. P. Kelley, Dr. Chalk, and numerous institutions in Canada, Australia and the United States which courteously responded to requests for material.

FINANCE

The audited accounts of the Department will be published in the *Oxford University Gazette*. The following is a summary of income and expenditure for the year.

General Account

Income. Forestry Commission, £5,348; Colonies, £5,000; Colonial Development and Welfare Fund, £4,208; Curators of the University Chest, £2,570; Dominions, India and others, £725; other receipts, £261. Total Income, £18,112.

Expenditure. Staff Salaries and Pension Contributions, £13,259; Instructional Supplies, £2,056; Furniture, £255; Travelling, £1,257; Administrative and Miscellaneous Expenses, £1,810; Publications, £361; Instalment on loan from Capital Account, £50. Total Expenditure, £19,048.

APPENDIX I

PUBLICATIONS

GENERAL:

Relations of Empire Forestry with the United Nations' Food and Agriculture Organization. H. G. Champion. *Proc. Fifth British Empire Forestry Conference,* 1947.

The Imperial Forestry Institute in 1947. H. G. Champion. *Loc. cit.*

Forestry in the Commonwealth and Great Britain, 1946. Col. A. H. Lloyd. *Encyclopaedia Britannica Book of the Year.*

FOREST BOTANY:

New or Noteworthy Plants from West Tropical Africa. A. C. Hoyle and J. P. M. Brenan. *Kew Bulletin*, 1947, pp. 67-74.

On the Relationships of Lannea Barteri. (*Oliv.*) *Engl.* A. C. Hoyle and the late A. P. D. Jones. *Kew Bulletin*, 1947, pp. 75-86.

A New Species of Cola from Tanganyika Territory. J. P. M. Brenan and the late A. P. D. Jones. *Bulletin du Jardin Botanique de l'Etat.* Vol. XVIII (fas. 1 & 2), pp. 1-6.

FOREST PATHOLOGY:

On the effect of changes in elevation, aspect, slope and depth of free-rooting material on the growth of European Larch, Japanese Larch, Sitka Spruce and Scots Pine in Mynydd Ddu Forest. W. Day. *Forestry* XX, 1947, pp. 9-20.

The leaf scorch of planes, caused by Gnomonia veneta. *Quart. Journ. Forestry* XLI, 22.

[A memorandum on 'An investigation into the relationship between rate of growth, the occurrence of root disease and butt-rot and the climatic and especially the edaphic environment of the tree' was submitted to the Forestry Commission on December 2nd, 1946.]

FOREST ECONOMICS:

Labour Costs in English Forestry since 1824. J. J. MacGregor. *Forestry*, Vol. XX, 1946.

The World's Timber Problems, Resources and Trade. (Accepted for publication in *Wood.*)

FOREST UTILIZATION:

Operations of Military Forestry Companies, 1909-1945. Col. A. H. Lloyd. *O.U.F.S. Journal*, 1946.

Forest Management: Reviews of Administration Reports, etc.

Kenya Arbor Forestry, 1945. N. V. Brasnett. *Emp. For. Review*, Vol. 25, No. 2, pp. 288-289.

Northern Rhodesia, 1945, Nyasaland, 1945. *Emp. For. Review*, Vol. 25, No. 1, pp. 143-144, and For. Dev. Plan ten years N. Rhodesia, Vol. 26, No. 1, pp. 110-112. N. V. Brasnett. *Emp. For. Review*.

Forest Mensuration:

Brief reviews of Lesnaya Promyshlennost, Nos. 5, 6, 7, 8, 9 and 12 of 1945. M. L. Anderson. *Emp. For. Review*, Vol. 25, No. 2, 1946.

Translation of an article on 'Aviation in Forestry' by G. A. Mokeev. (Russian.) M. L. Anderson. *Emp. For. Review*, Vol. 25, 1946, pp. 277-280.

Review of an article by Prof. Tkachenko in *Les* on 'Radical Changes in Timber Utilization and Problems of Forestry Reconstruction,' 1945. M. L. Anderson. *Emp. For. Review*, Vol. 26, No. 1, 1947, p. 112.

Review of 'Forestry Practice,' Bulletin No. 14 re-issued by the Forestry Commission, 1946. M. L. Anderson. *Emp. For. Review*, Vol. 26, No. 1, 1947, p. 106.

Forest Ecology.

Soil Conditions and Tree Growth, I. Physiological Aspects of the Tree Soil Complex. Dr. L. Leyton. *Chemistry and Industry*, 1947, pp. 558-560.

Soil Conditions and Tree Growth, II. Soil Factors. G. W. Dimbleby and Dr. L. Leyton. *Chemistry and Industry*, 1947, pp. 560-562.

APPENDIX II

STAFF

I. STAFF ENGAGED IN INSTRUCTION AND RESEARCH

PROFESSOR H. G. CHAMPION, C.I.E., M.A. (Oxon.). Tropical Forestry, Forest Policy.

*L. CHALK, M.A., D.Phil. (Oxon.). Wood Structure and Properties.

*W. R. DAY, M.A., B.Sc. (Oxon.). Pathology, Forest Hygiene.

*A. H. LLOYD, O.B.E., M.C., T.D., M.A. (Oxon.). Forest Engineering and Utilization.

*†R. N. CHRYSTAL, D.Sc. (Edin.), Hon. M.A. (Oxon.). Forest Zoology.

‡N. V. BRASNETT, M.A., Dip.For. (Cantab.). Forest Management and Mensuration.

*¶M. L. ANDERSON, M.A. (Oxon.), D.Sc. (Edin.). Mensuration.

*J. J. MACGREGOR, B.Sc. (Glasgow), M.S. (Wisc.), B.Litt. (Oxon.). Forest Economics.

*§E. W. JONES, M.A. (Oxon.), Ph.D. (Cantab.). Silviculture.

*W. R. C. HANDLEY, Ph.D. (Leeds). Microbiology.

*L. LEYTON, Ph.D. (Leeds). Tree Physiology.

*G. W. DIMBLEBY, M.A., B.Sc. (Oxon.). Forest Ecology.

*J. P. M. BRENAN, M.A. (Oxon.). Tropical Forest Botany.

‖P. J. RENNIE, B.Sc. (Lond.). Soil Research.

‖P. E. W. MURPHY, B.Agr.Sci. (Dublin). Soil Research.

II. STAFF ENGAGED SOLELY IN RESEARCH FOR THE FORESTRY COMMISSION

R. G. SANZEN-BAKER, B.Sc. (Edin). Forestry Commission Research Officer for England and Wales. Silviculture.

III. STAFF OF OTHER UNIVERSITY DEPARTMENTS ASSISTING IN INSTRUCTIONAL WORK

A. C. HOYLE, M.A., B.Sc. (Oxon.). Forest Botany and Ecology.

C. G. T. MORISON, M.A. (Oxon.). Soil Science.

G. R. CLARKE, M.A., B.Sc. (Oxon.). Soil Science.

O. H. CHILTON, M.A., M.Sc. (Lond.). Surveying.

D. J. FINNEY, M.A. (Cantab.). Statistical Method.

IV. OTHER STAFF

Secretary: MISS H. M. EDWARDS.
Assistant Secretary: MISS J. M. POLLARD.
Librarian: MISS G. GUINEY.
Assistant Librarian: MISS I. S. T. ASPIN, M.A. (Oxon.).

* These members of the Staff have the status of University Demonstrators (Forestry).
† Dr. R. N. Chrystal reappointed from 1.8.47 for five years.
‡ Mr. N. V. Brasnett for two years from 1.10.46.
§ Dr. E. W. Jones from 1.8.45.
‖ These members of the Staff were appointed for three years from 1.4.47.
¶ Dr. M. L. Anderson appointed for five years from 1.12.46.